Raytheon JTRS/SCA Deployment
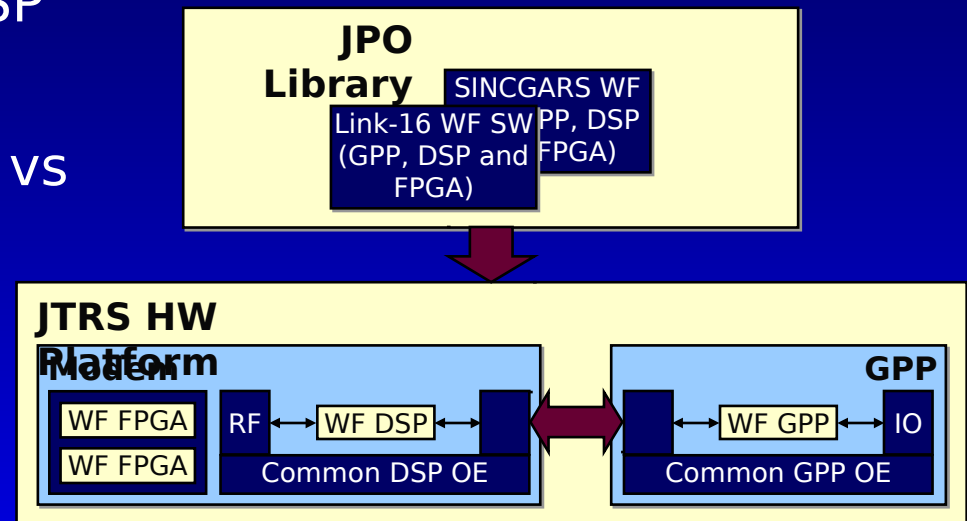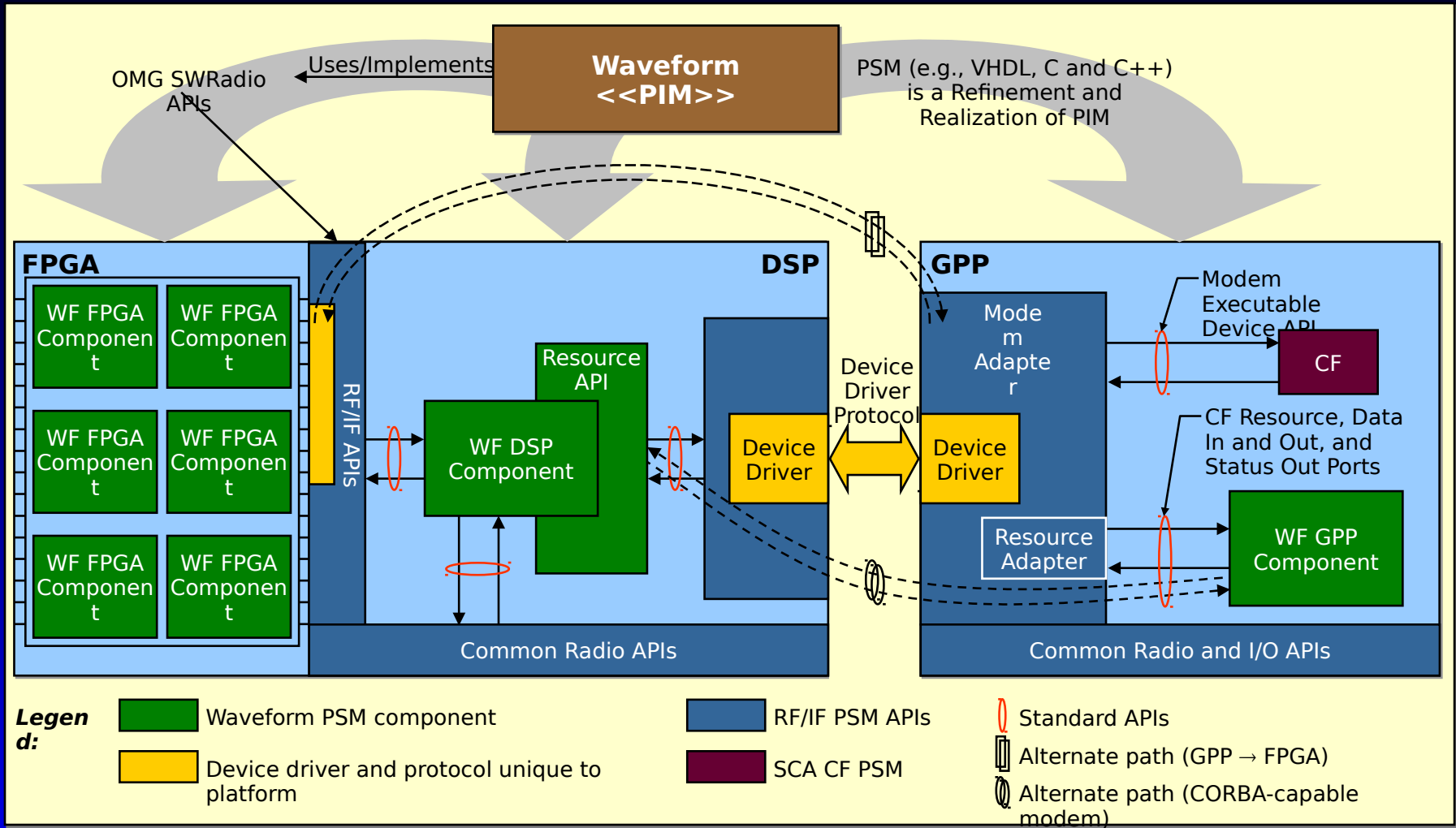
Briefing to JTRS JPO Industry Days

29 April 2004

Approach to Achieving Portability in Signal Processing

- Overall waveform development process is critical
  - OMG model driven architecture approach
  - Platform specific model (PSM) as realization of platform independent model (PIM)
- Standardized abstraction layer APIs
  - Required to facilitate ease of movement of waveform components to GPP and DSP
- Use Resource Adapters
  - Minimize impact of CORBA vs non-CORBA environments
- Standardized FPGA design/implementation
  - Produces library for FPGA components

JPO Library

SINCGARS WF
Link-16 WF SW (GPP, DSP and FPGA)
PP, DSP FPGA)

JTRS HW Platform

Modem

GPP

| WF FPGA | RF | WF DSP | | | WF GPP | IO |
| WF FPGA | | Common DSP OE | | | Common GPP OE | |

Map platform-independent waveform design – establish standard APIs

Realization of PIM Design to Target Components

Waveform <<PIM>>

OMG SWRadio APIs ← Uses/Implements

PSM (e.g., VHDL, C and C++) is a Refinement and Realization of PIM

FPGA

WF FPGA Component	WF FPGA Component
WF FPGA Component	WF FPGA Component
WF FPGA Component	WF FPGA Component

RF/IF APIs

DSP

Resource API

WF DSP Component

Device Driver

Device Driver Protocol

Common Radio APIs

GPP

Modem Adapter

Device Driver

Resource Adapter

Modem Executable Device API

CF

CF Resource, Data In and Out, and Status Out Ports

WF GPP Component

Common Radio and I/O APIs

Legend:

🟩 Waveform PSM component	🟦 RF/IF PSM APIs	⬭ Standard APIs
🟨 Device driver and protocol unique to platform	🟥 SCA CF PSM	▯ Alternate path (GPP → FPGA)
		⬭ Alternate path (CORBA-capable modem)

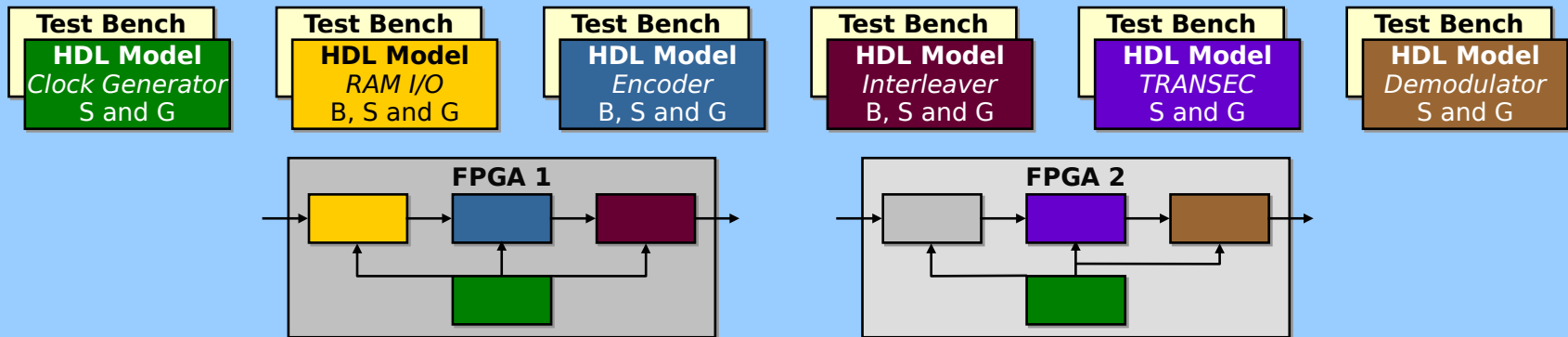## *Standardize critical APIs – allow for architecture changes*

OMG SWRadio APIs

- Common radio APIs
  - Provides common service definitions that are applicable for all applications (waveforms or radio control)
  - File services, OMG services and lightweight services (log, event, naming, etc.)
  - Operating system APIs (RT POSIX subset)
    - Pthreads
    - Semaphores
    - Time
- Common layer APIs
  - Provides interfaces that cross-cut through facilities that correlate to layers; these interfaces can be viewed as building blocks for SWRadio components that realize multiple interfaces
  - Protocol data unit, error control, flow control, measurement, quality of service and stream facilities
- Physical layer APIs
  - Modem APIs
    - Modem facilities include all digital signal processing elements required to convert bits into symbols and vice versa
  - RF/IF APIs
    - RF/IF facilities is used to configure and control basic devices of physical channel; granularity at which these interfaces are implemented is not specified
  - I/O APIs
    - Defines configuration properties for audio and serial facilities

4/29/20

FPGA Portability

- Use of off-the-shelf cores (from Xilinx, Altera and many others) is a current example of FPGA portability
  - Industry will deliver waveform-component cores into a JTRS library
- FPGA portability should not be tied to a particular vendor or device family
  - Device technology changes too rapidly
  - Different applications have different HW constraints
  - Vendor-specific tools, functions or HW features cannot be used in portable cores
- Interfaces should use standard protocols and/or formats
  - May be necessary to distinguish between internal and external interfaces to maximize speed of internal interfaces
  - Industry-driven standard interconnection mechanisms are being developed that have potential to greatly aid portability
- Portability is enhanced by using parameters to greatest extent possible in HDL, avoiding use of literals

HDL Reuse Library – Test Bench and Model (Behavioral, Synthesizable and Gate)

Test Bench	Test Bench	Test Bench	Test Bench	Test Bench	Test Bench
HDL Model *Clock Generator* S and G	**HDL Model** *RAM I/O* B, S and G	**HDL Model** *Encoder* B, S and G	**HDL Model** *Interleaver* B, S and G	**HDL Model** *TRANSEC* S and G	**HDL Model** *Demodulator* S and G

FPGA 1

FPGA 2

Summary

- Raytheon brings extensive experience in SCA/JTRS compliance above and below 2 GHz
  - Formed and led Modular Software Radio Consortium (MSRC)
    - Developed SCA 2.2 and delivered to JPO
    - Developed SCA 2.2 compliant core framework
  - Developer of SCA-compliant radios and SATCOM terminals
    - Microlite   • JTT Upgrade
    - NMT   • MBMMR Upgrade
    - AITG Upgrade   • HC3 Study
    - UltraComm • NetFires
- Impractical to mandate a common HW solution for all applications
  - Significant risk of mandating a soon-to-be obsolete solution given rapid progression of technology
  - Different platforms and services have significantly different HW requirements
    - Size, weight and power
    - Environmental and nuclear hardening
    - Form factor
    - Platform and baseband interfaces
- A HW-independent approach to DSP and FPGA portability will produce major benefits in development cost, schedule and LCC

Software-Defined Radios

JTRS Demo
4-Channel
3/4 ATR

UltraComm

UltraComm

JTT
Joint Tactical Terminal

Airborne Integrated Terminal
Bringing High Speed UHF Satcom to the Warfighter

Raytheon
Integrated Broadcast Service
Intelligence Communication for the 21st Century

Raytheon

NMT

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